

BATTLEFIELD INFORMATION CONCEPTS FOR THE HIGHLY MOBILE WARRIOR

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Introduction

With the advent of the Objective Force, future warriors will need to retrieve critical information in a timely manner while operating in a highly mobile environment. One method to accomplish this employs a small, secure, wireless, and lightweight device that can display relevant battlefield information in a useable format based on the current location. This can be done by leveraging and modifying commercial hardware systems and integrating military applications built to commercial specifications. The Research, Development and Engineering Center (RDEC), Communications-Electronics Command (CECOM), Fort Monmouth, NJ, is exploring advanced concepts such as these through both in-house and contractor research and development programs in support of warrior-based efforts. This article describes some of the ongoing advanced research projects that involve lightweight mobile devices for the battlefield.

The lessons learned from these research projects will provide valuable insight into new concepts and provide the groundwork for their application in future development

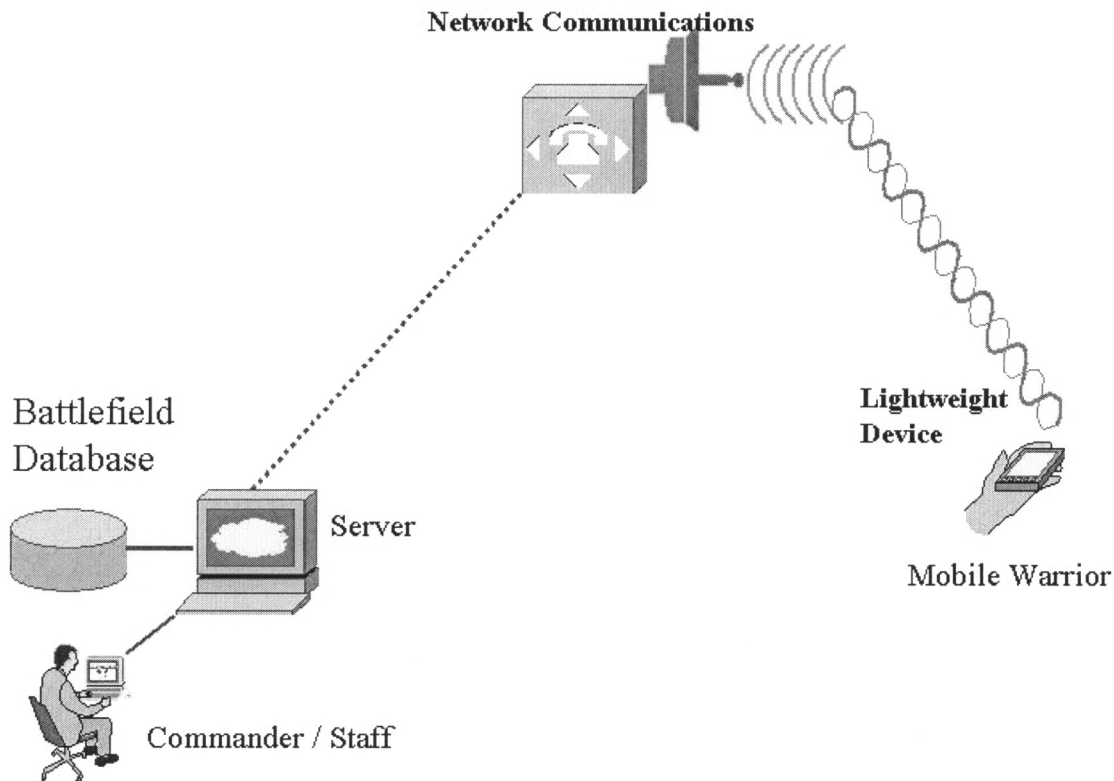
and PM programs. One in-house effort explores the most efficient approach to retrieve battlefield data, such as the Joint Common Database (JCDB), from remote sources. There is also a current Small Business Innovative Research (SBIR) solicitation to develop a lightweight system that incorporates self-aware location-based services and decision aids with a long-range communications link. Both of these research projects will enable the Army to explore lightweight mobile concepts and decide the appropriateness of this technology in the acquisition of future fielded systems.

For a soldier on the battlefield, the information must be timely and accurate. Commercial technology can be leveraged, but does not currently meet all the requirements of a battlefield system. Several additional system requirements are imposed on the soldier beyond that of a commercial mobile information system. These additional requirements include security of the communications link, weight/power of the mobile station, ruggedness of the system, interoperability with legacy systems, ease of use, and visual organization. The combination of

these conditions results in a unique system solution. The goal of the research efforts at CECOM for the mobile warrior involves developing an architecture for a system to retrieve and transmit current battlefield information over an intermittent secure wireless communications link to a lightweight device and to demonstrate portions of this architecture with prototype devices. (See figure on Page 24.)

Until recently, technology was not mature enough to allow for battlefield information to be presented to mobile, dismounted front-line commanders in a timely fashion. As the Army begins to field a wearable computing device to extend digitized command and control (C2) to the front-line soldier, CECOM is exploring even smaller and lighter devices for the future. An envisioned scenario has the dismounted commander retrieving military database information over a wireless link on a lightweight device in a timely manner. Just as a mobile salesman can retrieve daily appointments and sales order information, the future soldier will be able to retrieve critical information on the battlefield that will

Battlefield Wireless Database Retrieval



allow him to win the battle quickly and with fewer friendly casualties.

Information Retrieval Issues

One project, an Independent Laboratory In-house Research (ILIR) effort in the C2 Directorate, involves examining the system architecture, software architecture, and latency issues associated with database retrieval and synchronization using lightweight devices in a mobile environment. Database retrieval in a military environment has four special conditions that make the problem of mobile information retrieval unique. Soldiers cannot dock computing devices at the end of the day and synchronize them over a wired connection to a large remote database. For this reason, all data communications must be over a wireless communications link with limited channel capacity. For the soldier, his

information is time-critical. The soldier must be aware of the enemy's actions or location or he might die. The soldier may be out of communications range for extended periods of time and cannot wait until he exits a "dead zone" in communications coverage. Therefore, he must constantly have a subset of critical information with him at all times, indicating the timeliness and accuracy of this information. The soldier must be able to transmit and receive his information without it being compromised through eavesdropping. Failure of the soldier's mobile database retrieval system in any of these areas could result in, at a minimum, the soldier being unable to accomplish the mission and possibly that soldier or other soldiers being injured or killed.

The ILIR effort will explore methods to perform database retrievals

and/or synchronizations with large remote databases over a wireless link. The impact of dead zones and periods of time without connectivity will be examined. A means by which critical information can be pre-cached on the user's device will be investigated. All of this will be accomplished within the size, weight, and power restrictions of a surrogate lightweight mobile device.

Synchronization

A key issue for our mobile system is mobile database synchronization with centrally located databases (i.e., JCDB). This problem can be approached in several ways. Full offline replication could be attempted but is not a solution for two reasons: data transmission time and limited storage capacity on the lightweight mobile device. Partial replication combined with some

means of communications connectivity sensing is one approach that is being explored. Another technique, push-pull of data based on time-stamping with some type of pre-caching critical data, shows the most promise based on initial analysis. Finally, an ad hoc query system with local storage is also being examined.

As part of this research effort, wireless packets will be captured to determine the actual traffic load on the communications channel for each scheme proposed. The load on the communications channel will be a key factor in the final system selection because channel capacities are limited on the modern battlefield. Storage and memory footprints on the lightweight mobile device as well as processing requirements will also be key elements in the final evaluation of the system architecture.

In the previous projects, several software and system architecture issues have already been addressed. There is also an SBIR effort to develop both C2 software and a unique prototype lightweight computing device. This effort will develop Web-enabled, location-specific, decision aid applications and host them on a lightweight device (such as a handheld platform) with long-range reachback communications capability. (See figure on Page 24.) The primary focus will be to develop location-specific military software applications that can retrieve relevant information from remote sources based on the user's current location. These lightweight-compatible applications should automatically retrieve (either push or pull) remote database information that is relevant to the warfighter based on current location and/or situation awareness.

Design Phase

Issues that will be addressed during the design phase include protocol transmission, transmission efficiencies, and unique approaches to

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push/pull information to a mobile warfighter with intermittent communications connectivity. Techniques to sense when communications capability is present and pre-send (push) information during these optimum times must be developed. This system will also be able to display color maps. The system will enable the warfighter to use an extremely lightweight device to extract real-time situation awareness and intelligence information from remote sources and databases and display this information on his portable device. At the completion of this effort, a small self-contained prototype system consisting of warrior-specific software loaded on several lightweight devices communicating over a long range through a link with a central server will be demonstrated and delivered. As part of this effort, data retrieval from XML files and databases representative of the JCDB will be explored.

Conclusion

The Army is migrating to a modern digital battlefield. Because commanders use lightweight data devices for their day-to-day work when not at war, they will expect the same information flow on the battlefield. These ongoing projects at CECOM explore several means to accomplish this using simulated battlefield data. The

projects will provide the valuable groundwork for fielding a portable data device capable of secure wireless database and information retrievals under battlefield conditions. These advanced exploratory efforts leveraging commercial technology at CECOM will ensure that the warfighter has the latest information technology incorporated into his battlefield systems to allow him to act first and decisively to win the battle.

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